

Healthcare workers' role in keeping MMR vaccination uptake high in Europe: a review of evidence

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Measles is a highly contagious and potentially fatal disease. Europe is far from the 95% coverage rates necessary for elimination of the disease, although a safe and cost-effective vaccine is available. We reviewed the literature on studies carried out in European countries from January 1991 to September 2011 on knowledge, attitudes and practices of health professionals towards measles vaccination and on how health professionals have an impact on parental vaccination choices. Both quantitative and qualitative studies were considered: a total of 28 eligible articles were retrieved. Healthcare workers are considered by parents as a primary and trustworthy source of information on childhood vaccination. Gaps in knowledge and poor communication from healthcare workers are detrimental to high immunisation rates. Correct and transparent information for parents plays a key role in parental decisions on whether to have their children vaccinated. Healthcare workers' knowledge of and positive attitudes towards measles-mumps-rubella (MMR) vaccination are crucial to meeting the measles elimination goal. An effort should be made to overcome potential communication barriers and to strengthen vaccine education among healthcare professionals.

Introduction

Measles is a highly contagious disease and a leading cause of death among children below five years-old worldwide, although a safe and cost-effective vaccine is available [1]. Although measles usually runs a simple course, serious complications can occur: the most common in industrialised countries are otitis media (in 7–9% of cases), pneumonia (1–6%), diarrhoea (8%), post-infectious encephalitis (1 per 1,000–2,000 cases), subacute sclerosing panencephalitis (SSPE) (1 per 100,000 cases) and death (1–3 per 1,000 cases) [2]. Women who are infected during pregnancy are at greater risk of miscarriage and premature delivery [2]. Individuals at high risk of developing complications are children under 5 years of age, adults and individuals with chronic diseases and impaired immunity [1,3].

The most common way of administration of the measles vaccine is in combination with the mumps and rubella vaccines (the trivalent mumps-measles-rubella (MMR) vaccine), which is a combination of the three live attenuated viruses. Since its introduction in the 1970s, an estimated 500 million doses of MMR vaccine have been administered in over 60 countries worldwide [4]. Some countries have adopted a quadrivalent vaccine (MMRV), which also includes varicella [5].

Before vaccines were available, measles affected most people by adolescence; today, thanks to routine vaccination programmes, the disease is not seen as frequently in Europe. Eliminating measles and congenital rubella syndrome – that is, reducing to zero the incidence of infection [6] – is a goal that all European countries are committed to meet by 2015 [6,7]. In order to eliminate measles, it is necessary to reach and maintain measles vaccination coverage at 95% [1,7]. Currently, however, the vaccination coverage is still far from this level: in fact, a drop in vaccine coverage rates to suboptimal levels has been reported in Europe in recent years [8,9].

In the first eight months of 2011 alone, more than 29,000 cases of measles were reported in Europe. About one third of them required hospitalisation and in the first six months of the year, measles was responsible for eight deaths and 24 cases of acute encephalitis [9].

Currently there is no standard European policy of administration of the MMR vaccine: of 30 European countries, vaccines are administered at the paediatrician's office in 7, in healthcare centres in 12, and in multiple locations in 11 [10, and data from European Centre for Disease Prevention and Control (ECDC) experts for Malta and Romania]. There are also considerable discrepancies in the administration schedules of the MMR vaccine among European Union (EU) countries: although the first dose is always recommended by the age of 18 months in all countries, age at the second dose of MMR vaccine varies widely, from 12

TABLE 1

System of vaccine delivery and age at first and second measles-mumps-rubella vaccine dose as recommended by national programmes, by EU/EFTA country

Country	System	Age		
		First dose	Second dose	Catch-up vaccination
Austria	Combined	12–24 m	<24 m	7–9 y, 9–17 y
Belgium	Combined	12–13 m	10–13 y	5–7 y, 14–16 y
Bulgaria	GP/FD-based	13 m	12 y	–
Cyprus	Paediatrician-based	12–15 m	4–6 y	11–12 y
Czech Republic	Paediatrician-based	15 m	21–25 m	–
Denmark	GP/FD-based	15 m	12 y	–
Estonia	GP/FD-based	12 m	13 y	–
Finland	GP/FD-based	14–18 m	6 y	–
France	Combined	12–15 m	25 m	<6 y
Germany	Combined	11–14 m	15–23 m	–
Greece	Paediatrician-based	12–15 m	4–6 y	–
Hungary	Combined	15 m	11 y	–
Iceland	Combined	18 m	12 y	–
Ireland	GP/FD-based	12–15 m	4–5 y	11–12 y
Italy	Combined	12–15 m	11–15 y	–
Latvia	GP/FD-based	15 m	7 y	12 y
Lithuania	Combined	15–16 m	6–7 y	12 y
Luxembourg	Combined	15–18 m	5–6 y	–
Malta	Paediatrician-based ^a	13 m	3 y	–
Netherlands	GP/FD-based	14 m	9 y	–
Norway	GP/FD-based	15 m	12–13 y	–
Poland	GP/FD-based	6–7 m	10 y	11–12 y
Portugal	Combined	15 m	5–6 y	–
Romania	GP/FD-based ^a	12–15 m	6–7 y	–
Slovakia	Paediatrician-based	14 m	10 y	–
Slovenia	Paediatrician-based	12–24 m	5–6 y	–
Spain	Paediatrician-based	12–15 m	3–6 y	–
Sweden	GP/FD-based	18 m	12 y	–
Switzerland	Combined	12 m ^a	15–24 m ^a	–
United Kingdom	GP/FD-based	13 m	40 m	–

Combined: both general practitioners/family doctors and paediatricians; EFTA: European Free Trade Association; EU: European Union; GP/FD: general practitioner/family doctor; m: months; y: years.

^a Data from European Centre for Disease Prevention and Control (ECDC) experts.

Source: unless otherwise indicated, data adapted from the EUVACnet vaccination schedules [5], Van Esso et al. [10] and VENICE report [11].

months to 15 years [11]. Some EU countries have also implemented catch-up vaccination programmes, which are very heterogeneous in terms of age of those eligible (Table 1).

In spite of the solid evidence base on the efficacy and safety of measles vaccination [2], attitudes and practices of healthcare workers in Europe appear at times erratic: the misconception that measles is not a serious threat to health persists, not only among the parents of young children, but also among healthcare providers [12]. In this sense, there is complacency towards measles that is not present with regard to other vaccine-preventable diseases such as polio, tetanus or

bacterial meningitis, which are generally perceived as extremely serious threats to health [12]. Memory of diseases and their severity fades quickly: because of routine vaccination programmes, there are generations of doctors, nurses and parents who have never seen measles or complications caused by measles.

Especially after a British study linked the MMR vaccine to increased incidence of autism, Crohn disease and other disorders [13], coverage in some European countries dropped, resulting in measles outbreaks and consistent burden of disease and costs [12]. Although the vaccine–autism controversy was dismissed and the article retracted by the journal editors [14] and

although all possible associations were repeatedly disproven [15-17], the misconception that the vaccine risks outweigh those related to acquiring natural measles immunity is still widespread among parents [16]. Practices such as measles parties are said to have made a comeback in recent years [18] and anti-vaccination groups are common and active, especially on the Internet. Furthermore, the ever-increasing recourse to alternative practices such as homeopathy has been associated with higher rates of rejection of vaccines [19,20].

The objectives of our study were: (i) to review the literature produced in European countries on the knowledge, attitudes and practices of health professionals towards measles vaccination and (ii) to assess how health professionals have an impact on parental vaccination choices.

Methods

Eligibility criteria

Study types

Studies reporting the knowledge, attitudes and practices of healthcare workers (general practitioners, paediatricians, other doctors, nurses, midwives) towards

measles or MMR vaccination, as well as those reporting the influence of healthcare workers' attitudes on parental vaccination choices for their children, were eligible for inclusion. Both quantitative (surveys) and qualitative studies (focus groups) and reviews of literature focusing on one or more EU/European Economic Area (EEA) countries were searched.

Types of data

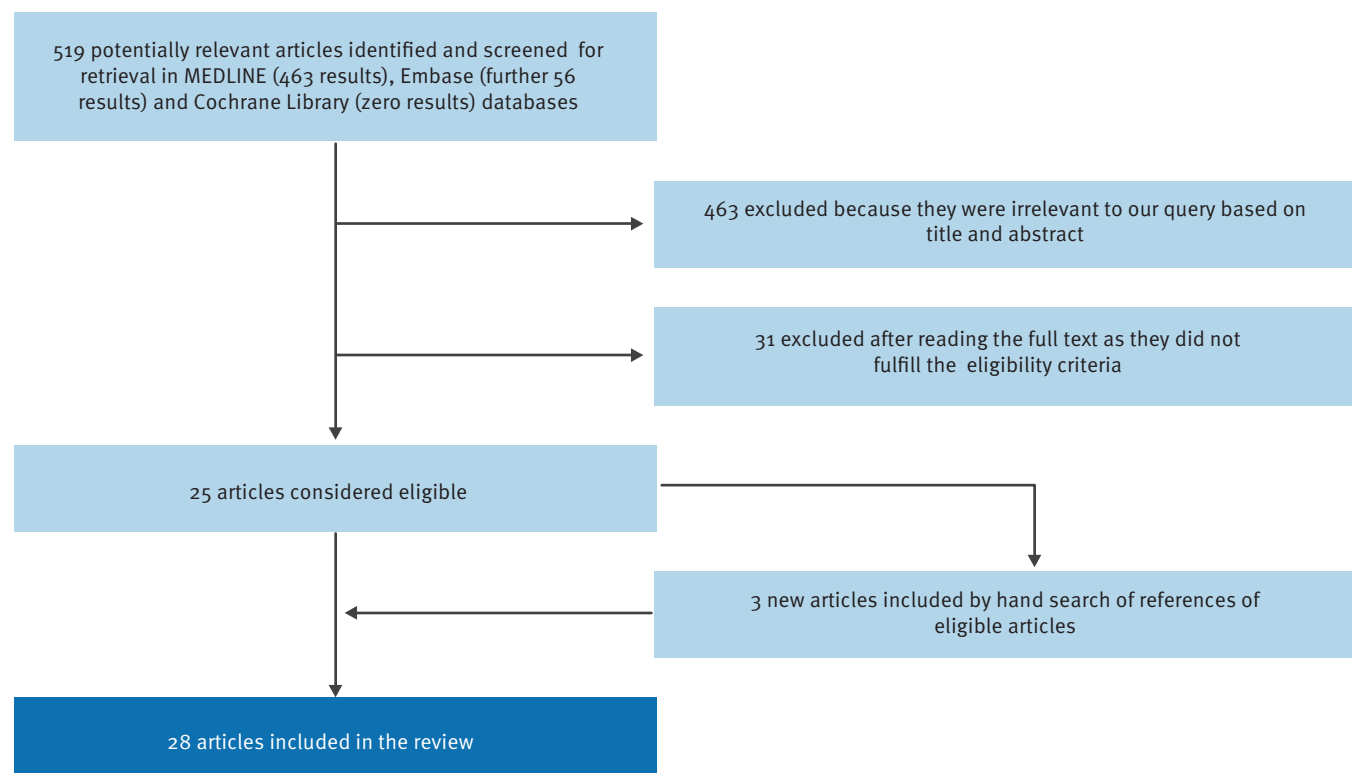
The types of data collected were: prevalence and characteristics (demographics, profession, practice/training in alternative medicine) of healthcare workers partially or entirely unfavourable to measles/MMR vaccination; common reasons for advising against vaccination; prevalence of unvaccinated children attributable to healthcare workers' knowledge, attitudes and practices; opinions of parents towards healthcare workers as a reliable source of information on MMR vaccine efficacy and safety; and common reasons for parental distrust towards healthcare workers.

Data sources and search methods for identification of studies

We searched MEDLINE and Embase. All records with the following terms were retrieved: attitude to health; health personnel OR parents; vaccine OR immunisation; Europe OR EU OR *[list of EU and EEA/European*

FIGURE

Search strategy for review of studies reporting knowledge, attitudes and practices of healthcare workers towards measles or MMR vaccination and those reporting the influence of healthcare workers' attitudes on parental vaccination choices



MMR: measles-mumps-rubella.

TABLE 2

Relevant studies reporting knowledge, attitudes and practices of healthcare workers towards measles or MMR vaccination and those reporting the influence of healthcare workers' attitudes on parental vaccination choices (n=28)

Study	Setting	Type of study	Study population
Anastasi et al. [21]	Nine randomly selected boards of physicians, Italy	Questionnaire survey	500 randomly selected paediatricians
Angelillo et al. [22]	Randomly selected kindergartens in Cassino (Frosinone) and Crotone, Italy	Questionnaire survey	841 mothers of infants
Comité français d'éducation pour la santé [23]	France	Questionnaire survey	2,000 general practitioners
Hak et al. [24]	Day-care centres associated with a large organisation, the Netherlands	Focus group and questionnaire survey	283 parents of 3-month to 5-year-old children
Petrovic et al. [25]	North Wales Health Authority Area, UK	Questionnaire survey	148 health visitors, 239 practice nurses and 206 general practitioners
Smith et al. [26]	Salford and Trafford Health Authority Area, UK	Questionnaire survey	136 general practitioners, 78 practice nurses, 40 health visitors
Cotter et al. [27]	Counties Cork and Kerry, Ireland	Focus group	47 parents, 23 public health nurses, 14 midwives, 12 practice nurses
Rotily et al. [28]	12 counties, France	Interview survey	7,382 parents of 3 year-old children
Theeten et al. [29]	125 randomly selected clusters in 107 municipalities, Flanders, Belgium	Interview survey	Parents of 1,354 children aged 18 to 24 months
Posfay-Barbe et al. [30]	Switzerland	Questionnaire survey	2,070 physicians subscribers to Infovac.net
Trier [31]	97 general practices in the county of Vestsjælland, Denmark	Questionnaire survey	171 general practitioners
Ernst [32,33]	Exeter, UK	Questionnaire survey	45 homeopaths
Schmidt et al. [34]	UK	Questionnaire survey	104 homeopaths and 22 chiropractors registered on three websites
Lehrke et al. [35]	Germany	Questionnaire survey	219 medically qualified homoeopathic and 281 non-homoeopathic physicians
McMurray et al. [36]	Five general practices in the Leeds area, UK	Interview survey (qualitative)	69 parents of children aged between 4 and 5 years; 12 healthcare workers
Ramsay et al. [37]	UK	Cross-sectional interview surveys	1,016 mothers of children aged ≤3 years
Pareek et al. [38]	Birmingham, UK	Questionnaire survey	300 mothers of children approaching a routine MMR vaccination
Coniglio et al. [39]	8 randomly selected day-care centres in Catania, Sicily, Italy	Questionnaire survey	Parents of 1,500 children aged 3–5 years
Impicciatore et al. [40]	6 geographically dispersed centres in Italy	Questionnaire survey	1,035 mothers of children 6 years-old or younger
Heininger [41]	Germany	Questionnaire survey	6,025 participants
Dannetun et al. [42]	County of Östergötland, Sweden	Interview survey	203 parents of children who had no date registered for MMR vaccination at a child health centre
Stefanoff et al. [43]	England, Norway, Poland, Spain, Sweden	Questionnaire and interview surveys	6,611 parents of children aged 0–2 years (England, Norway, Poland, Sweden) and 0–3 years (Spain)
Swennen et al. [44]	Belgium	Interview survey	Parents of 1,110 children from Flanders and 1,088 from Wallonia
Smith et al. [45]	UK	Interview survey	1,016 mothers of children aged ≤3 years
Brown et al. [46]	Papers published in English between 1987 and 2008	Review	31 studies (23 from Europe)
Hilton et al. [47]	Central Scotland, UK	Focus group	72 parents
Casiday et al. [48]	A primary care trust in north-east England, UK	Questionnaire survey	Parents of 996 children born from 1 Oct 2000 to 30 Sep 2002
Ciofi degli Atti et al. [49]	Italy	Interview survey	Parents of 4,602 children aged 2 years

MMR: measles-mumps-rubella; UK: United Kingdom.

Free Trade Association (EFTA) countries]. The Cochrane Library was also consulted. The search covered articles published from 1 January 1991 to 27 September 2011, the date of the search. No language restriction was applied in the search. Two researchers (PCS and BS) reviewed the records independently, then discussed and agreed on the eligibility of each study. All references of eligible articles were hand searched and evaluated.

Data extraction and analyses

The following information was extracted for each study: references, country/countries involved, setting and characteristics of the healthcare workers interviewed, including details of their professions, and summary of the relevant data.

Results

The MEDLINE search yielded 463 results and a further 56 results were obtained through Embase. No systematic review of measles/MMR was found in the search of the Cochrane Library. Of the 519 overall articles retrieved, 463 were discarded as the title and abstract were not relevant and 31 after reading the full text as they did not meet the eligibility criteria. A further three articles were retrieved through hand search of references from the eligible articles. A total of 28 articles overall were included, as shown in the Figure and Table 2.

Knowledge, attitudes and practices of healthcare workers towards measles/MMR vaccination

A 2009 survey conducted among 156 Italian paediatricians [21] reported that only 88% knew that measles vaccination was recommended in the country, and only 35% knew the vaccination calendar. As for perceptions of the utility of recommended vaccinations (including MMR), paediatricians were asked to assign a score on a scale from 1 to 10: only 10% of those sampled resulted very favourable (scores of 9 or 10), although this percentage was significantly higher among those who administered recommended vaccinations for infants (odds ratio (OR):3.3; 95% confidence interval (CI): 1.1–9.9). Only a quarter of respondents administered the recommended vaccinations (which include measles) (26%), whereas among paediatricians who did not normally administer vaccines, 81% still advised parents to have their children immunised for recommended vaccinations. A total of 83% of the paediatricians sampled routinely provided information about recommended vaccinations to their patients, whereas a lower percentage (78%) informed them about benefits and risks.

An article published in 1999 in the *Bulletin of the World Health Organization* [22] reported that around 10% of 841 mothers of kindergarten children sampled from two Italian towns declined MMR vaccination because they were advised against it by healthcare professionals before deciding.

A French survey from 2001 from the French Committee for Health Education (Comité français d'éducation pour la santé) [23] categorised the attitudes of 2 000 general practitioners towards MMR vaccination into those who were: (i) very favourable, i.e. those who vaccinated systematically following the vaccination calendar (41%); (ii) favourable, i.e. those who vaccinated depending on the situation and did not follow the vaccination calendar systematically (56%); and (iii) unfavourable, i.e. those who disregarded the vaccination calendar (3%). Overall, 6% of those sampled were very or rather unfavourable to MMR vaccination. Those who were unfavourable were mostly practitioners who practiced homeopathy and/or alternative medicine and who worked with higher social/educated classes. The vaccination practices of practitioners who were favourable to the vaccination were also likely to improve after further training on vaccination.

A survey performed in the Netherlands in 2005 [24], among 283 parents of children attending day-care centres, showed that a negative attitude towards future vaccinations was significantly more common among healthcare workers (OR: 4.2; 95% CI: 1.4–12.6) and highly educated parents (OR: 3.3; 95% CI: 1.3–8.6) than among other parents.

Following the MMR–autism controversy, several studies were carried out on practitioners' attitudes towards MMR vaccination in the United Kingdom (UK) and Ireland. In north Wales, Petrovik et al. [25] found in 2001 that knowledge and practice among 593 healthcare professionals regarding the second MMR dose varied widely: 48% of healthcare professionals had reservations about the policy of giving the second MMR dose and 3% disagreed with it.

From a UK survey from Smith et al. [26], 40% of the 136 responding physicians were unsure of the need for the second dose and around 10% thought it unnecessary.

In Ireland, a survey in 2001 among 86 general practitioners, nurses and parents [27] showed a negative impact on vaccination uptake due to health professionals' ambivalence about vaccinations, inability or unwillingness to answer parents' questions or lack of empathy with parents concerned about the alleged side effects of the vaccines.

A French telephone survey published in 2001 [28], among 7,382 parents, showed that the coverage was significantly higher among children attended by a paediatrician compared with children not attended by a paediatrician (90.9% vs 85.4%, $p < 0.001$).

A survey conducted in Flanders, Belgium, in 2004 [29] found that having completed the schedule for the MMR vaccine depended on the vaccinating physician: children mainly vaccinated by a general practitioner were less likely to be completely vaccinated (adjusted OR: 0.3; 95% CI: 0.1–0.7) than children mainly vaccinated

by a paediatrician (reference group) and children vaccinated in a baby clinic or day-care centre were more likely to have received a valid schedule (OR: 2.3; 95% CI: 1.8–5.1).

A survey conducted in Switzerland among physicians [30] showed that 93% of the 2,070 surveyed physicians agreed with current official vaccination recommendations and would apply them to their own children. As for MMR vaccine, however, more paediatricians had their children vaccinated with the vaccine according to the recommended schedule than the other physicians (OR: 2.8; 95% CI: 1.6–4.7). A statistically significant number of non-paediatricians (4.8%) did not have their own children vaccinated.

A total of 171 practitioners were interviewed in Denmark in a 1991 survey on their attitude with regard to the usefulness of MMR vaccination: all expressed a positive attitude, but only 56% of respondents expressed a wholeheartedly positive attitude. Average vaccination rates were connected with such attitudes, being 85% in practices with unreservedly positive attitudes and 69% in practices with more guarded attitudes [31].

Providers of complementary medicine and homeopaths

Providers of complementary medicine are sometimes reported as having a negative attitude towards immunisation in general, including MMR [32]. Some studies have shown that homeopathic physicians do not recommend or apply vaccinations as frequently as their allopathic colleagues [32–34].

A small study from Ernst et al. [33] in the UK (n=23) on homeopaths' attitudes towards vaccination showed that all non-medically qualified homeopaths refused vaccinations (13/13) but only 3 of the 10 medically qualified homeopathic physicians did so.

In a 2002 UK study [34], Schmidt and Ernst evaluated and compared the response of professional homeopaths, chiropractors and general practitioners to an inquiry about MMR vaccination. Of 104 homeopaths who responded to the survey, 40 advised explicitly against immunisation; another 26 withdrew their answer after being told that the query was, in fact, part of a research project. Out of 63 chiropractors, 3 advised against immunisation and 27 withdrew their answers.

Lehrke et al. [35] performed a study in 2001 among medically qualified homeopathic practitioners and non-homeopathic physicians (both generalists and paediatricians) in Germany about the administration and recommendation of 17 different vaccinations in their practices. The study showed that the responding homeopathic physicians (n=219) did not generally refuse vaccines but rather viewed them with a specific hierarchy: the 'classical' vaccines against tetanus,

diphtheria and poliomyelitis were applied to nearly the same degree as by their non-homeopathic colleagues (n=281); however, vaccines against childhood diseases, including measles, were judged as ineffective and accepted with more restraint by homeopathic physicians.

A 2001 French survey [28] involving 7,382 parents showed that coverage rates were significantly lower among children whose parents exclusively or sought advice from a homeopath (70%), as compared with children whose parents never (92.1%) or sometimes (90.1%) did.

Impact of healthcare workers knowledge, attitudes and practice on parental vaccination choices for their children

Primary care providers have a central role in educating their patients on the safety and effectiveness of the MMR vaccine and can influence the rates of MMR immunisation just by answering parents' questions and addressing common misconceptions [36].

Several studies across Europe report that parents consider healthcare workers to be the most important source of information when deciding whether their children should be immunised with the MMR vaccine: 74% of mothers from a nationally representative sample of over 1,000 in a 2002 survey conducted in England reported seeking advice from health professionals before having their children immunised with the vaccine [37]. Information provided by healthcare workers was considered as the most influential and reliable by 77–78% of the respondents in a 2000 UK survey involving 300 mothers [38].

In a 2011 study [39] conducted in Sicily, one of the Italian regions with relatively high MMR vaccine coverage rates (87%), the great majority of parents interviewed (74%) singled out family paediatricians as the most important source of information. A total of 63% of mothers interviewed in a 2000 study [40] conducted in Italy also reported paediatricians to be their most important information source.

In Germany, 95% of respondents considered their paediatrician as the most important source of information in a 2006 online survey [41]; doctors and nurses from Child Health Centres were trusted as the most important source by 77% of interviewed parents in Sweden in 2005 [42].

The first results from the European *Vaccine Safety, Attitudes, Training and Communication* (VACSATC) project of 2010 [43] – comparing five cross-sectional surveys of parents with children less than three years of age in England, Norway, Poland, Spain and Sweden (6,611 respondents) – showed that healthcare providers ranked first among most used and most trusted sources of information on vaccines. Health professionals were

the most trusted by 92% of respondents in England; in Norway, the public health nurse was the most used source (49%) and the public health doctor the most trusted (67%); in Poland and Spain, the primary care physician was both the most used (79% and 85%, respectively) and most trusted (82% and 87%, respectively) source; in Sweden the public health nurse was used as main source of information by 82% of respondents and was the most trusted by 87%.

The attitude of the physician was mentioned as being very influential in the decision to vaccinate a child in the French-speaking community in Belgium [44].

In contrast, another survey conducted in the UK in 2007 showed a sharp drop in the level of trust in health professionals [45]. However, a 2010 systematic review by Brown et al. showed that parents are more likely to trust the information given to them by their general practitioners, health visitor or practice nurse than by the government: this relationship was observed in all five studies on the topic ($p < 0.05$ in three of the five) [46].

As seen in several studies, trust in individual health professionals and vaccine policymakers can be compromised by perceived conflicting interests (such as 'toeing the party line', meeting targets and giving financial compensation to doctors who reach high vaccine coverage rates) [36,47]. Health providers who were too resolute about the safety of the MMR vaccine led to parents questioning the providers' motives and knowledge; conversely, when the healthcare providers sounded vague, some parents interpreted this as concern that the vaccine was unsafe [47]. Such perceptions can be counteracted to some degree by trust in professional expertise and by healthcare workers sharing their personal experience (for example, confirming that they have vaccinated their own children) [36].

One of the most recurrently reported reasons for low vaccine acceptance rates is dissatisfaction with the adequacy of information provided to parents: a survey conducted in 2005 in the UK showed that 53% of respondents felt that doctors were too dismissive of parents' concerns about vaccine side effects. This figure rose to 89% among those who declined vaccination for their children [48].

A national survey conducted in Italy in 2003 showed that lack of appropriate information accounted for 22% of the missed or delayed MMR/measles vaccinations and intercurrent illness for 29% [49].

Discussion

Measles is a serious threat to public health: elimination of the disease in the EU is not only feasible, but necessary. Europe failed to meet the goal of eliminating measles by 2010, because of lower-than-required vaccination coverage. The commitment has been renewed, to eliminate measles by 2015 [50]. However, instead

of a progressive reduction of the disease in Europe, incidence and the number of outbreaks increased dramatically over the past 15 years, with unacceptable consequences in terms of mortality, morbidity and costs.

From our review, it is quite clear that doctors and other healthcare providers are regarded as the most reliable sources of information from parents. Healthcare workers are generally trusted and consulted on whether children should be vaccinated and they are in a good position to empower parents to take an informed decision about MMR vaccination for their children. If this is a reassuring thought, it has to be noted that trust towards healthcare workers on motives to vaccinate and safety and efficacy of the vaccine can be compromised if inadequate or vague information is provided or a conflict of interest perceived. For example, a history of safety issues cannot be denied but have to be explained in a clear and transparent manner. Parents need to be educated to make an informed choice.

Although a small percentage of practitioners, especially providers of complementary medicine, are against vaccines on principle, we found that the main problem among healthcare providers was lack of knowledge. In most cases, suboptimal vaccination rates resulted from inadequate knowledge among healthcare providers of vaccination schedules, as well as the benefits and side effects. In some cases, healthcare providers were even found to have misleading beliefs about immunisation and sent unclear or untrue messages to parents. Whenever healthcare workers' knowledge was found to be inadequate, vaccination coverage in the general population decreased. The same happened when healthcare workers were reported to have a relaxed attitude towards measles, which is itself a consequence of lack of knowledge of the disease infectivity and morbidity.

Even among providers of complementary medicine, medically qualified homeopaths tended to have a less negative attitude towards immunisation as compared with non-medically qualified practitioners [33].

A limitation of our study is related to the search strategy. Studies published in journals that are not indexed in MEDLINE and/or Embase (or cited in their references) were not included in the review: this might have caused us to overlook some evidence produced and published at a national level, especially in languages other than English. We know of at least one paper, published in the German *Epidemiologisches Bulletin* in 2008 [51], that was not included in the review for this reason, although the topic was relevant to our query. The authors surveyed attitudes and knowledge of childhood vaccination among 549 German midwives: about a quarter of the midwives interviewed did not support the administration of the MMR vaccine to children and over 40% considered diseases such as measles important for the personal development of the child. The survey also reported that over 10% of the sample

disagreed with the statement 'measles infection can be fatal'. The survey showed a significantly lower support for MMR vaccination among midwives trained in alternative medicine ($p=0.025$); furthermore, midwives who declared that they were against the administration of the vaccine were less likely to inform parents about the availability of the vaccine ($p=0.009$).

Another potential limitation of this review is that all the studies considered were produced in western Europe (Table 2). This might warrant caution in the interpretation of the results. Attitudes and knowledge of immunisation among healthcare providers might not be the biggest problem in lower-resource countries, as in some Central and Eastern European countries, where low coverage rates might also be due to logistic and organisational issues in vaccine delivery. However, it should be noted that, with the exception of Romania (4,015 confirmed cases), the major outbreaks of measles in 2011 were reported in western European countries: France (15,206 confirmed cases), Italy (5,181 confirmed cases) and Spain (1,986 confirmed cases) [52]. For these countries, low vaccination coverage rates, and thus the high incidence of measles, are unarguably, at least in part, a consequence of a general complacency towards the disease and of loose strategies for vaccination coverage. This is partly due to false myths and anti-vaccine propaganda and partly to the fact that vaccination has made measles an uncommon disease, diluting perceptions and memories of how threatening it can be.

In order to improve vaccination coverage, therefore, it is fundamental to raise awareness about the disease and fill any knowledge gaps of healthcare workers, providing them with evidence-based information on vaccines and educating them to communicate effectively with patients and parents; this could be attained through dedicated websites and by emphasising vaccine education in the medical and nursing curricula. The Council of the European Union [53] has invited Member States to make efforts along these lines.

Similar to the situation for healthcare workers, we found that there was a small proportion of parents who were very reluctant to have their children vaccinated with the MMR vaccine, regardless of proof of its efficacy and safety. However, most vaccine-decliners are simply under-informed or received misconceived information [24,28,36,37,43,48]. Better informed and trained health professionals could have a substantial impact on the vaccination choices of those parents. For example, the results of Ciofi degli Atti et al. are indicative of the fact that more efforts are needed to educate mothers (as well as physicians) regarding the risks associated with measles, as well as the fact that intercurrent illness is rarely a contraindication to immunisation [49].

Reaching 95% vaccine coverage is a priority for Europe. Measles was eliminated in 2002 in the Americas through universal coverage and active case surveillance [54].

One of the reasons behind this successful story in the Americas was good coordination among a consortium of countries. The Pan American Health Organization developed an enhanced and, most importantly, integrated disease elimination strategy [55].

The successful experience in the Americas shows the added value of addressing measles elimination at the European level. No country in Europe can attain it individually: only a joint effort will succeed.

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